Monitoring of Waterways for Mosquito Insecticides in Suffolk County, New York

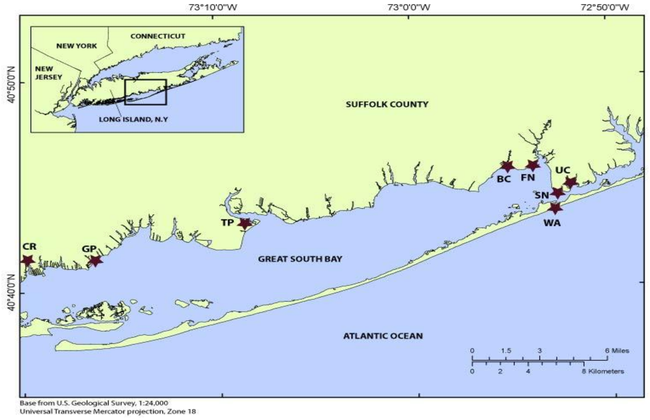
By Tristen N. Tagliaferri and Irene J. Abbene

Abstract

To date, the majority of field studies on mosquito insecticides have been in freshwater ecosystems and do not give insight into the environmental fate, persistence, and toxicity of these compounds in marine ecosystems. One objective of this study was to measure the presence and concentration of a wide range of mosquito insecticides, including those currently used by the Suffolk County Vector Control (SCVC), in water, suspended sediment, and bed sediment in salt marshes of Long Island, N.Y., as well as the relationship between these concentrations and the total organic carbon content of the sediment. Another objective was to evaluate the toxicity of the treated salt marsh bed sediment to the amphipod *Hyallela azteca*.

Sample sites include the salt marshes Beaverdam Creek (BC), Gardiner's Park (GP), Fireplace Neck (FN), Smith Point North (SN), Timber Point (TP), Unchachoque Creek (UC), and Fire Island Wilderness Area (WA). The freshwater non-tidal Carlls River (CR) was also sampled. Whole water and bed sediment samples were collected in 2009 approximately 30 minutes after aerial applications of Altosid® (methoprene) and Scourge® [1:3 ratio of resmethrin and the synergist piperonyl butoxide (PBO)] to determine the environmental fate and persistence of these insecticides. Bed sediment samples were collected in 2010 after aerial applications of Altosid® and Scourge® to measure the pesticide concentrations and to evaluate the toxicity of the sediment to *H. azteca*.

Methoprene and resmethrin were detected in filtered water samples, suspended sediment, and bed sediment. PBO was detected in filtered water samples and bed sediment. Dichlorodiphenyltrichloroethane (DDT) and metabolites *p,p'*-dichlorodiphenyldichloroethylene (DDE) and *p,p'*-dichlorodiphenyldichloroethane (DDD) were detected in bed sediment. DDE and DDD were also detected in suspended sediment. Initial analysis indicates a correlation exists between the concentration of methoprene and the percent of organic carbon in the sediment (r (8) = 0.77, p = .02). Five of 13 sediment toxicity samples collected in 2010 were considered toxic to *H. azteca*. There is no relationship between percent mortality and concentrations of insecticides present in the 2010 samples; however, a positive correlation exists between percent organic carbon and percent mortality (r (13) = 0.56, p =.04). This suggests that other adsorbed compounds not analyzed for may be contributing to the toxicity observed.

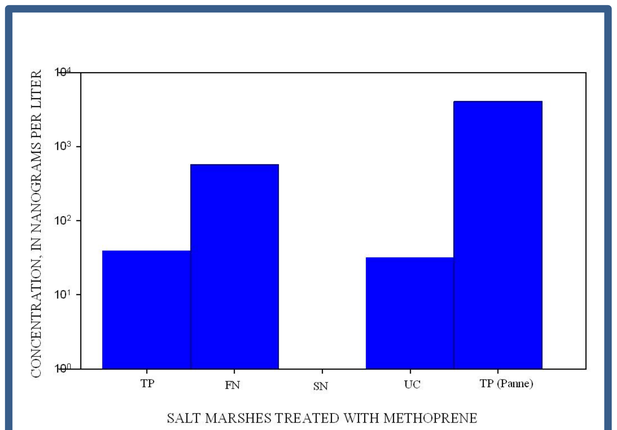


Locations of sampling sites in Suffolk County, N.Y., 2009-10.

Contact information:

Tristen N. Tagliaferri
U.S. Geological Survey
2045 Route 112, Building 4
Coram, NY 11727
(631) 736-0783 x 118
tpetecca@usgs.gov

Irene J. Abbene
U.S. Geological Survey
2045 Route 112, Building 4
Coram, NY 11727
(631) 736-0783 x 117
iabbene@usgs.gov



Reported concentrations of methoprene in filtered water collected during August-September 2009 from salt marshes on the south shore of Long Island, N.Y. approximately 30 minutes after methoprene application.

Methods

Environmental samples were collected in August and September, 2009 and 2010. Three bed sediment samples were collected in April 2010 for quality assurance purposes. Water samples were collected at the waters' surface by dipping the sample container to maximum depth of 0-2 cm below the surface ("grab samples") to minimize the potential for sample contamination or to disturb the natural stratification of the water column. Each field site was different which forced the use of a variety of collection methods for the bed sediment samples. These samples were collected by using one or a combination of a Teflon spoon, a sediment push-corer, and a "pooper-scooper." All equipment was collected and cleaned by techniques described by the U.S. Geological Survey (variously dated). All samples were shipped on ice overnight to lab. Samples were prepared and analyzed for insecticide concentration and organic carbon content at the USGS Research Laboratory in Sacramento, California. Analyses were completed in accordance with Hladik and others (2008). Bed sediment samples collected in 2010 for sediment toxicity analysis were sent to the USGS Columbia Environmental Research Center (CERC) in Missouri. These samples were prepared and analyzed using a toxicity analysis in accordance with Ingersoll and others (1995).

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Michelle Hladik, USGS Sacramento, CA
Christopher Ingersoll, USGS Columbia, MO

Timber Point in Great River, N.Y.

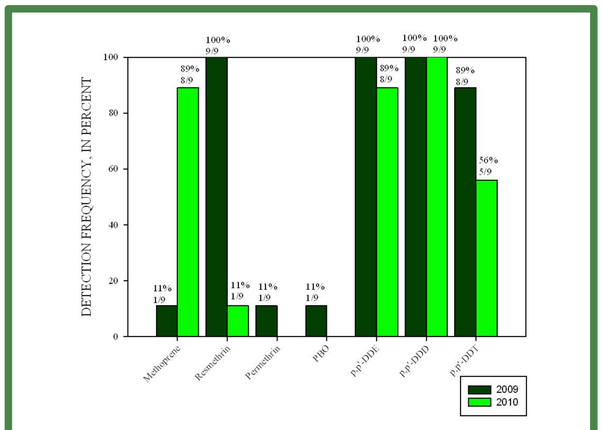
Unchachoque Creek in Shirley, N.Y.

References:

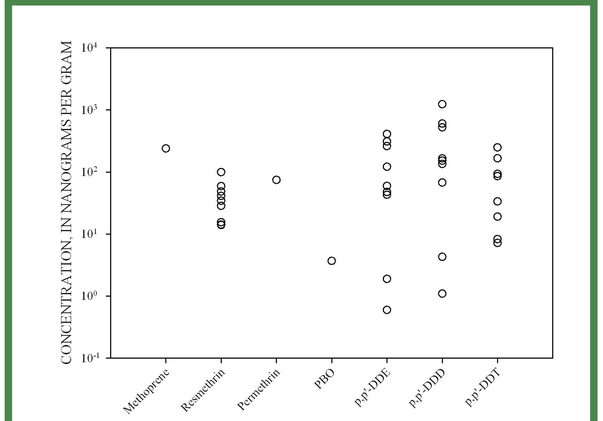
Hladik, M.L., Smalling, K.L., and Kuivila, K.A., 2008, A multi-residue method for the analysis of pesticides and pesticide metabolites in water using HLB solid-phase extraction and gas chromatography-ion trap mass spectrometry: Bulletin of Environmental Contamination and Technology, v. 80, p. 139-144.

Ingersoll, C.G., Ankley, G.t., Benott, D.A., Brunson, E.L., Burton, G.A., Dwyer, F.J., Hoke, R.A., Landrum, P.F., Norberg-King, T.J., Winger, P.V., 1995, Toxicity and bioaccumulation of sediment-associated contaminants using freshwater invertebrates: A review of methods and applications: Environmental Toxicity, v 14, p. 1885-1894.

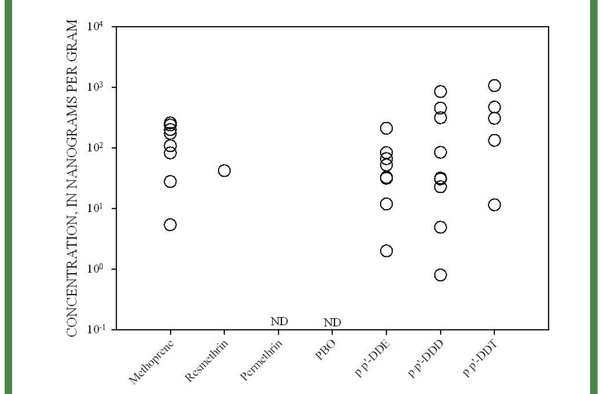
U.S. Geological Survey, variously dated, National field manual for the collection of water-quality data: U.S. Geological Survey Techniques of Water-Resources Investigations, book 9, chaps. A1-A9, v 2, variously paged [Also available online at http://pubs.water.usgs.gov/twri9A. Chapters originally published from 1997-1999; http://water.usgs.gov/owq/FieldManual/mastererrata.html]



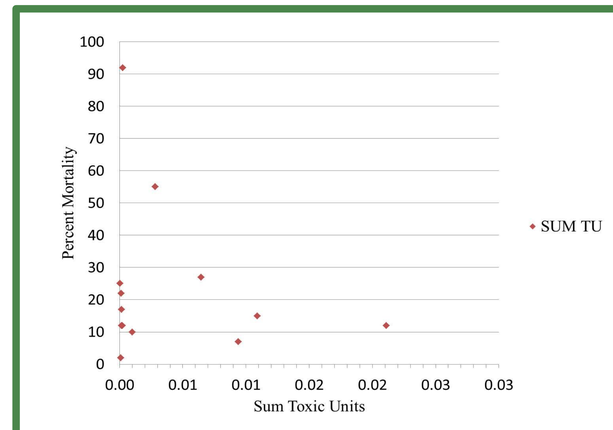
Frequency of detected analytes in bed sediment collected during August-September 2009 and 2010 among seven brackish tidal wetlands (BC, GP, FN, SN, TP, UC, WA) and one non-tidal river (CR) on the south shore of Long Island, N.Y.



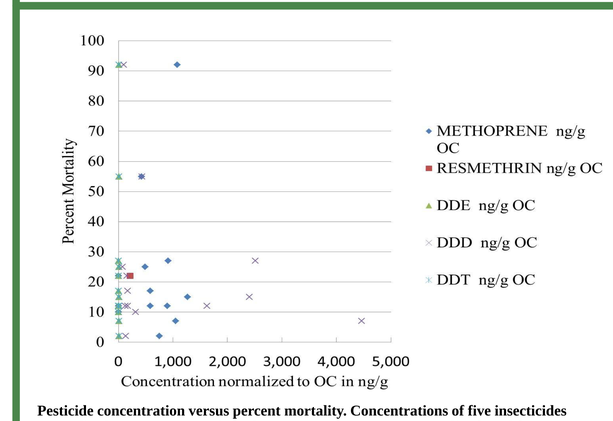
Reported concentrations of detected analytes in bed sediment collected during August-September 2009 from four brackish tidal wetlands (FN, SN, TP, and UC) and one freshwater non-tidal river (CR) on the south shore of Long Island, N.Y.



Reported concentrations of detected analytes in bed sediment collected during August-September 2010 from five brackish tidal wetlands (BC, GP, FN, SN, and UC) after pesticide applications on the south shore of Long Island, N.Y.

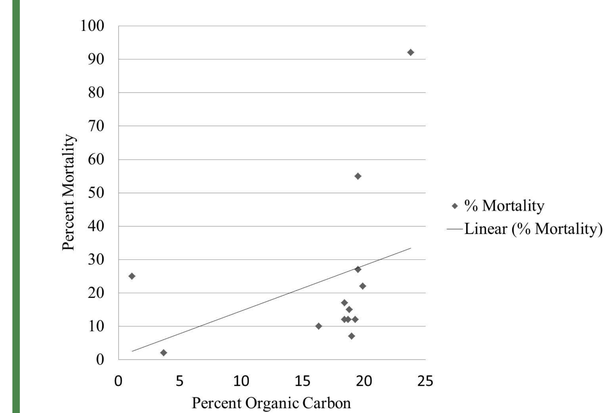


Sum toxic units (SUM TU) versus percent mortality. Correlation between calculated sum TU's of DDT, DDD, and DDE versus percent mortality found for *H. azteca* in 13 samples collected from BC, GP, FN, SN, and TP in 2010.



Pesticide concentration versus percent mortality. Concentrations of five insecticides normalized to percent organic carbon (OC) versus percent mortality found for *H. azteca* in 13 samples collected from BC, GP, FN, SN, and TP in 2010.

[ng/g OC, nanograms per gram normalized to percent organic carbon]



Percent mortality versus percent organic carbon. Correlation between percent mortality and percent organic carbon observed in 13 bed sediment samples distributed among six sites in Suffolk County, N.Y., 2010.